

# 29th EACSL Annual Conference on Computer Science Logic

CSL 2021, January 25–28, 2021, Ljubljana, Slovenia (Virtual  
Conference)

Edited by

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## ■ Preface

This volume contains the papers presented at CSL 2021, the 29th edition in the series of Computer Science Logic (CSL), the annual conference of the European Association for Computer Science Logic (EACSL).

CSL 2021 was held in Ljubljana, Slovenia, 25-28 January 2021, virtually due to the enduring SARS-Cov2 (Covid-19) outbreak.

CSL started as a series of international workshops, and became an international conference in 1992. Previous editions of CSL were held in Barcelona (2020), Birmingham (2018), Stockholm (2017), Marseille (2016), Berlin (2015), Vienna (2014), Torino (2013), Fontainebleau (2012), Bergen (2011), Brno (2010), Coimbra (2009), Bologna (2008), Lausanne (2007), Szeged (2006), Oxford (2005), Karpacz (2004), Vienna (2003), Edinburgh (2002), Paris (2001), Munich (2000), Madrid (1999), Brno (1998), Aarhus (1997), Utrecht (1996), Paderborn (1995), Kazimierz (1994), Swansea (1993) and San Miniato (1992).

CSL is an interdisciplinary conference, spanning across both basic and application-oriented research in mathematical logic and computer science. It is a forum for the presentation of research on all aspects of logic and applications, including automated deduction and interactive theorem proving, constructive mathematics and type theory, equational logic and term rewriting, automata and games, game semantics, modal and temporal logic, logical aspects of computational complexity, finite model theory, computational proof theory, logic programming and constraints, lambda calculus and combinatory logic, domain theory, categorical logic and topological semantics, database theory, specification, extraction and transformation of programs, logical aspects of quantum computing, logical foundations of programming paradigms, verification and program analysis, linear logic, higher-order logic, non-monotonic reasoning.

CSL 2021 received 82 submissions from 28 countries. The programme committee selected 34 papers for presentation at the conference. Each paper was reviewed by at least three members of the programme committee, with the help of external reviewers. The submission and reviewing process, programme committee discussion, and author notifications were all handled by the EasyChair conference management system. In addition to the contributed papers, there were five invited talks, by

- Sophia Drossopoulou (Imperial College, London, UK)
- Bartek Klin (Universytet Warszawski, Warszawa, Poland)
- Assia Mahboubi (INRIA and LS2N, Université de Nantes, France, and Vrije Universiteit Amsterdam, the Netherlands)
- Sylvain Schmitz (Université de Paris, CNRS, IRIF, France and IUF, France)
- Linda Brown Westrick (Department of Mathematics, Penn State University, University Park, PA, USA).

We thank the five invited speakers for contributing to the success of the conference with their interesting talks and papers.

A special regular item in the CSL programme is the Ackermann Award presentation. This is the EACSL Outstanding Dissertation Award for Logic in Computer Science. This year, the jury decided to give the Ackermann Award for 2020 to

Benjamin Lucien Kaminski for his PhD thesis *Advanced Weakest Precondition Calculi for Probabilistic Programs*

supervised by Joost-Pieter Katoen at the RTWH Aachen University, Germany.

29th EACSL Annual Conference on Computer Science Logic (CSL 2021).

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The award was officially presented at the conference on January 26th, 2021. The citation of the award is included in the proceedings.

We are very grateful to all the members of the CSL 2021 programme committee and external reviewers for their careful and efficient evaluation of the papers submitted. We would like to thank also the members of the organisation committee, Alex Simpson, Andrej Bauer, and Danel Ahman, for taking care of every detail to make the conference enjoyable for all the participants, a task that was made all the more arduous because of the particular sanitary conditions of the year 2020. It was also a pleasure to work with Thomas Schwentick who, as the EACSL president, provided excellent guidance. The proceedings of CSL 2021 are published as a volume in the LIPIcs series. We thank Michael Wagner and all the Dagstuhl/LIPIcs team for their ongoing support and for the high quality preparation of these proceedings.

Christel Baier and Jean Goubault-Larrecq

November 10th, 2020.

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## ■ Ackermann Award 2020

By Mikołaj Bojańczyk, Prakash Panangaden and Thomas Schwentick,  
for the Jury of the EACSL Ackermann Award

The sixteenth Ackermann Award is presented at CSL'21 in Ljubljana, Slovenia (virtually). The 2020 Ackermann Award was open to any PhD dissertation on any topic represented at the annual CSL and LICS conferences that were formally accepted by a degree-granting institution in fulfillment of the PhD degree between 1 January 2018 and 31 December 2019. The Jury received eight nominations for the 2020 Award. The candidates came from a number of different countries around the world. The institutions at which the nominees obtained their doctorates represent six different countries in Europe and North America.

Again this year, EACSL Ackermann Award is generously sponsored by the association Alumni der Informatik Dortmund e.V.<sup>1</sup>

The topics covered a wide range of areas in Logic and Computer Science as represented by the LICS and CSL conferences. All submissions were of a very high quality and contained significant contributions to their particular fields. The jury wish to extend their congratulations to all the nominated candidates for their outstanding work.

The wide range of excellent candidates presented the jury with a difficult task. After an extensive discussion, one candidate stood out and the jury unanimously decided to award the **2020 Ackermann Award** to:

Benjamin Lucien Kaminski from Germany, for his thesis  
*Advanced Weakest Precondition Calculi for Probabilistic Programs*  
approved by *RWTH Aachen* in 2019.

### Citation

Benjamin Lucien Kaminski receives the *2020 Ackerman Award* of the European Association of Computer Science Login (EACSL) for his thesis

*Advanced Weakest Precondition Calculi for Probabilistic Programs.*

The major contribution of the thesis is calculi – in the style of weakest precondition calculus – for tasks such as: proving bounds on expected running time (e.g. finite expected running time), proving almost sure termination, or computing conditional expected values. Due to the subtle nature of probabilistic programs, these are results which require extraordinary skill. At the same time, the thesis is expected to make – in fact, it already has made – an important impact due to the promising and wide-ranging applications. Finally, the quality of exposition is exemplary. With almost 400 pages of well chosen examples and lucid explanations, the thesis can serve as a textbook for newcomers in the field.

### Background of the Thesis

Kaminski has made substantial advances in the analysis of probabilistic programs, a topic which – apart from its traditional importance in the study of programming languages – has

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<sup>1</sup> [www.cs.tu-dortmund.de/nps/en/Alumni/index.html](http://www.cs.tu-dortmund.de/nps/en/Alumni/index.html)



also recently assumed a central role in the field of machine learning. Program analysis is a major topic in programming languages since the seminal work of the Cousot's in the 1970's. In the case of probabilistic programs the issues are very subtle, since one cannot simply assert that a certain property holds. One must incorporate probabilistic reasoning at the very heart of the analysis. Following Dexter Kozen's seminal contributions to probabilistic program semantics and probabilistic dynamic logic in the 1980s, many workers have developed this subject.

There was a flowering of ideas connected with reasoning about probability since Kozen's work. These include Joost-Pieter Katoen, Kaminski's advisor, Christel Baier, Nathalie Bertrand and Marta Kwiatkowska among others on probabilistic model checking, Kim Larsen, Arne Skou, Josée Desharnais, Radha Jagadeesan, Vineet Gupta and Prakash Panangaden on probabilistic bisimulation and related metrics, Catuscia Palamidessi and her many collaborators on topics related to privacy and security, just to give a sample. In more recent times probabilistic programming languages like Church and Anglican have emerged from the machine learning community with fascinating results from, for example, Nate Ackerman, Cameron Freer and Dan Roy. It is clear that the topic of probabilistic programming languages and logics is not a niche topic, indeed an Ackerman Award had previously been given to Matteo Mio in 2013 for research on probabilistic logic.

## **Contributions of the Thesis**

Kaminski's thesis extends the expectation calculus of McIver and Morgan which is the probabilistic analogue of Dijkstra's weakest precondition calculus in a significant way, by allowing signed measures instead of probability measures. His thesis contains a striking new compositional analysis of expected running times, which goes far beyond the older approach which could only infer almost-sure termination. Also for almost-sure termination, the thesis contains progress in the shape of a new proof rule, which can be applied, for example, to easily prove almost-sure termination of the 1-dimensional random walk. Apart from expected running times and almost-sure termination, Kaminski also develops a new calculus for reasoning about conditioning in probabilistic programs; which is of particular importance in the context of machine learning.

Finally, apart from proof calculi, the thesis also includes analysis of the computational complexity of deciding termination for probabilistic programs. A highlight of this analysis is the result that the questions "does a program terminate almost surely on a given input?" and "does a program terminate almost surely on all inputs?" occupy the same place in the arithmetical hierarchy; despite the seeming greater difficulty of the second question.

The numerous innovations in this thesis will have a long lasting impact on the theory and practice of probabilistic programming.

## **Biographical Sketch**

Benjamin Kaminski carried out his PhD (under the supervision of Joost-Pieter Katoen) at RWTH in Aachen Germany, which is also where he completed his undergraduate studies. His work on probabilistic programs has received the Best Paper award at ETAPS 2016. He is currently a Lecturer at the University College of London.

## Jury

The jury for the **Ackermann Award 2020** consisted of eight members, two of them *ex officio*, namely, the president and the vice-president of EACSL. In addition, the jury also included a representative of SIGLOG (the ACM Special Interest Group on Logic and Computation).

The members of the jury were:

- Christel Baier (TU Dresden),
- Michael Benedikt (University of Oxford),
- Mikołaj Bojańczyk (University of Warsaw),
- Jean Goubault-Larrecq (ENS Paris-Saclay),
- Prakash Panangaden (McGill University),
- Simona Ronchi Della Rocca (University of Torino), the vice-president of EACSL,
- Thomas Schwentick (TU Dortmund University), the president of EACSL,
- Alexandra Silva, (University College London), ACM SigLog representative.

## Previous winners

Previous winners of the Ackermann Award were

### 2005, Oxford:

Mikołaj Bojańczyk from Poland,  
Konstantin Korovin from Russia, and  
Nathan Segerlind from the USA.

### 2006, Szeged:

Balder ten Cate from the Netherlands, and  
Stefan Milius from Germany.

### 2007, Lausanne:

Dietmar Berwanger from Germany and Romania,  
Stéphane Lengrand from France, and  
Ting Zhang from the People's Republic of China.

### 2008, Bertinoro:

Krishnendu Chatterjee from India.

### 2009, Coimbra:

Jakob Nordström from Sweden.

### 2010, Brno:

no award given.

### 2011, Bergen:

Benjamin Rossman from USA.

### 2012, Fontainebleau:

Andrew Polonsky from Ukraine, and  
Szymon Toruńczyk from Poland.

### 2013, Turin:

Matteo Mio from Italy.

### 2014, Vienna:

Michael Elberfeld from Germany.

### 2015, Berlin:

Hugo Férée from France, and  
Mickael Randour from Belgium.

### 2016, Marseille:

Nicolai Kraus from Germany

**0:xx Ackermann Award 2020**

**2017, Stockholm:**

Amaury Pouly from France.

**2018, Birmingham:**

Amina Doumane from France.

**2019, Barcelona (conference in 2020):**

Antoine Mottet from France.

Detailed reports on their work appeared in the CSL proceedings and are also available on the EACSL homepage.